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*June 1994*

# *Mathematics 30*

## *Grade 12 Diploma Examination*

Alberta
EDUCATION

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*June 1994*

# *Mathematics 30*

## *Grade 12 Diploma Examination*

### *Description*

Time allotted: 2.5 h. You may take an additional 0.5 h to complete the exam if needed.
Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

***Part A***
has 42 multiple-choice questions each with a value of one mark.

***Part B***
has 7 numerical-response questions each with a value of one mark.

***Part C***
has 4 written-response questions for a total of 21 marks.

A tear-out formula sheet, *z*-score page, and 90% Box Plots are included in this booklet.

All graphs on this examination are computer-generated.

### *Instructions*

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Carefully read the instructions for each part before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Do not fold the answer sheet.

***Note:*** *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

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# *Part A: Multiple Choice*

***42 Questions***

***Instructions***

- Consider all numbers used in the questions to be **exact real** numbers and not the result of a measurement.
- Read each question carefully and decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

  ***Example***

  This diploma examination is for the subject of

  **A.** biology
  **B.** physics
  **C.** chemistry
  **D.** mathematics

  Answer Sheet

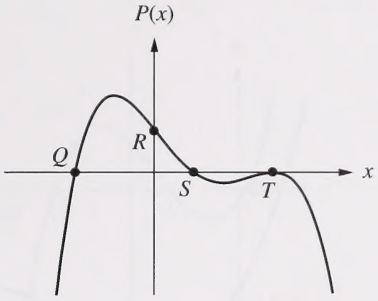
  Ⓐ Ⓑ Ⓒ ●

- **Use an HB pencil only.**
- If you wish to change an answer, erase **all** traces of your first answer.

***Note:*** *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

***Do not turn the page to start the examination until told to do so by the presiding examiner.***

**1.** The graph of a fourth-degree polynomial function $P(x)$ is shown below.




$P(x) = 0$ has four real roots, two of which are equal. On the graph, the point that corresponds to the equal roots is labelled

**A.** $Q$
**B.** $R$
**C.** $S$
**D.** $T$

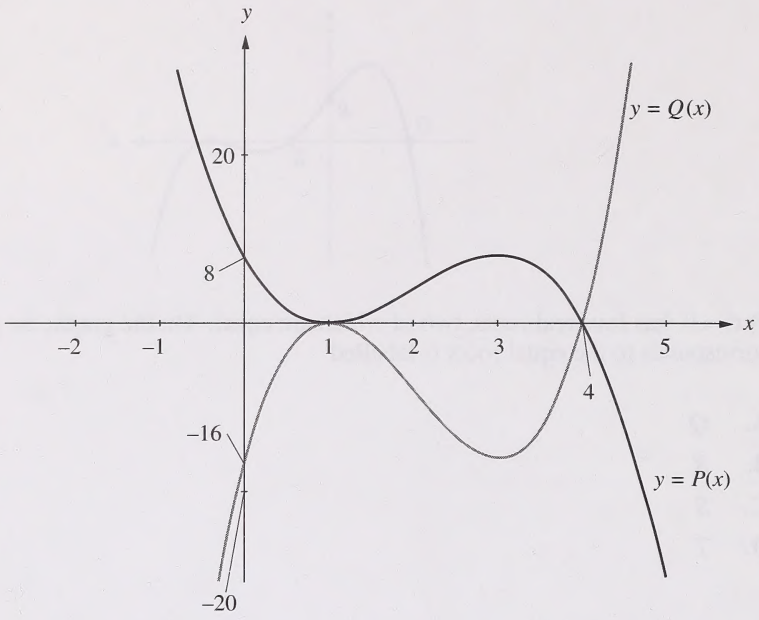
**2.** When a polynomial $P(x)$ is divided by $x - 4$, the remainder is 3. Which of the following **must** therefore be true?

**A.** $P(3) = 0$
**B.** $P(4) = 0$
**C.** $P(4) = 3$
**D.** $P(3) = 4$

**3.** When $x^5 + mx - 2$ is divided by $x - 1$, the remainder is 7. The value of $m$ is

**A.** 10
**B.** 8
**C.** –8
**D.** –10

**4.** The graphs of two third-degree polynomial functions $y = P(x)$ and $y = Q(x)$ are shown below.




Using the graph of $y = P(x)$ and the graph of $y = Q(x)$, what is the value of $a$ so that $Q(x) = aP(x)$ for all values of $x$ ?

**A.** 8

**B.** 2

**C.** –2

**D.** –8

**5.** If $P(0) = -5$, then which of the following statements about the polynomial $P(x)$ **must** be true?

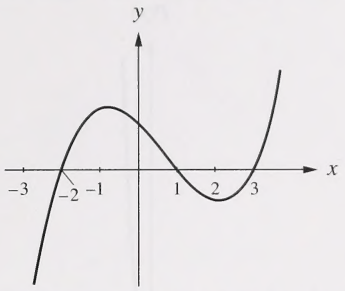
**A.** A factor of $P(x)$ is $x - 5$.

**B.** A factor of $P(x)$ is $x + 5$.

**C.** The constant term in $P(x)$ is 5.

**D.** The constant term in $P(x)$ is $-5$.

**6.** $P(x) = x^3 + bx^2 + cx + d$ is an integral polynomial function with zeros of $-2$, $1$, and $3$. A sketch of $y = P(x)$ is shown below.




The graph crosses the $y$-axis at

**A.** $(0, 2)$

**B.** $(0, 4)$

**C.** $(0, 6)$

**D.** $(0, 8)$

**7.** A second-degree polynomial $P(x)$ has exactly two zeros, $-2$ and $5$. If a new polynomial function $G(x)$ is found by multiplying $P(x)$ by $(x + 2)$, then the

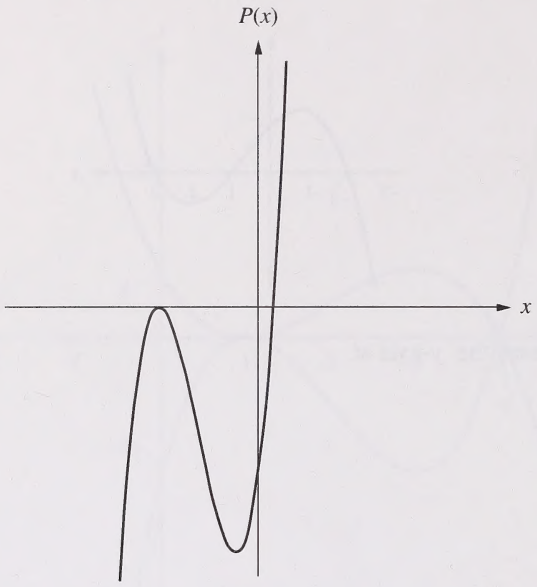
**A.** $y$-intercept of the graph of $y = G(x)$ will be two units below the $y$-intercept of $P(x)$

**B.** $y$-intercept of the graph of $y = G(x)$ will be double the $y$-intercept of $P(x)$

**C.** $x$-intercept of the graph of $y = G(x)$ will be $-4$ and $3$

**D.** $x$-intercept of the graph of $y = G(x)$ will be $0$ and $7$

**8.** The graph of a third-degree polynomial function of the form $P(x) = ax^3 + bx^2 + cx + d$ is shown below.




The values of $a$ and $d$ must satisfy

**A.** $a > 0,\ d < 0$

**B.** $a < 0,\ d > 0$

**C.** $a > 0,\ d > 0$

**D.** $a < 0,\ d < 0$

**9.** If $f(x) = 2x^3 + bx^2 + cx + 6$, $f(1) = -2$ and $f(2) = 12$, then the values of $b$ and $c$ respectively are

**A.** 5 and –15

**B.** 5 and –5

**C.** –5 and –5

**D.** –15 and 5

**10.** Twenty randomly selected high school students are asked if they own a car. Four students answer yes. Based on this sample, the 90% confidence interval for the percentage of students in the high school population who own a car is

**A.** 5% – 35%

**B.** 5% – 50%

**C.** 10% – 35%

**D.** 10% – 40%

**11.** Travis and Lulu each conduct a survey among randomly chosen Math 30 students, asking if they find the Math 30 course to be interesting. Of the 20 students surveyed by Travis, 16 find the course interesting. Of the 100 students surveyed by Lulu, 80 find the course interesting.

Based on their surveys, Travis and Lulu each construct a 90% confidence interval for the percentage of yeses in the population. A comparison of the confidence intervals they constructed shows that

**A.** the sample of 100 has a shorter confidence interval than does the sample of 20

**B.** the sample of 20 has a shorter confidence interval than does the sample of 100

**C.** the sample of 20 has a longer and more reliable confidence interval than does the sample of 100

**D.** the sample of 100 has a longer and more reliable confidence interval than does the sample of 20

**12.** An exam has a mean $\mu$ and a standard deviation $\sigma$. If the score on every paper was increased by $a$, then the new mean and standard deviation respectively would be

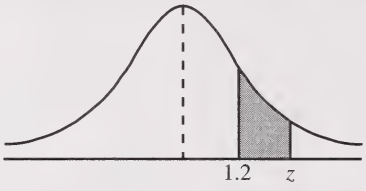
**A.** $\mu + a$ and $\sigma + a$

**B.** $\mu$ and $\sigma + a$

**C.** $\mu + a$ and $\sigma$

**D.** $\mu$ and $\sigma$

**13.** For the standard normal distribution shown below, the area of the shaded region is 0.1089.




The value of $z$ correct to the nearest tenth is

**A.** 4.9

**B.** 3.8

**C.** 2.5

**D.** 1.3

**14.** A manufacturer sells 30 000 computers in a year. The life expectancy of these computers is normally distributed with a mean life of 11 years and a standard deviation of 2 years. The number of computers that can be expected to break down within the first 7 years is

**A.** 600

**B.** 684

**C.** 14 316

**D.** 15 000

**15.** The results of a well-constructed random survey were published in a Canadian medical journal. The journal reports that 4 out of 10 Canadians wear eye glasses. A high school student replicates the survey in her school. After interviewing 500 students, she finds that 103 students wear eye glasses. Which of the following statements **best** explains this inconsistency?

**A.** The samples were drawn from different populations.

**B.** The medical journal's survey was not random.

**C.** The student's survey was not random.

**D.** The samples sizes were different.

**16.** Which of the following equations represents a trigonometric function with a vertical translation of two units upwards and a phase shift of $\frac{\pi}{3}$ to the right in relation to $y = \sin\theta$?

**A.** $y = 2\sin\left(\theta + \frac{\pi}{3}\right)$

**B.** $y = 2\sin\left(\theta - \frac{\pi}{3}\right)$

**C.** $y = \sin\left(\theta - \frac{\pi}{3}\right) + 2$

**D.** $y = \sin\left(\theta + \frac{\pi}{3}\right) + 2$

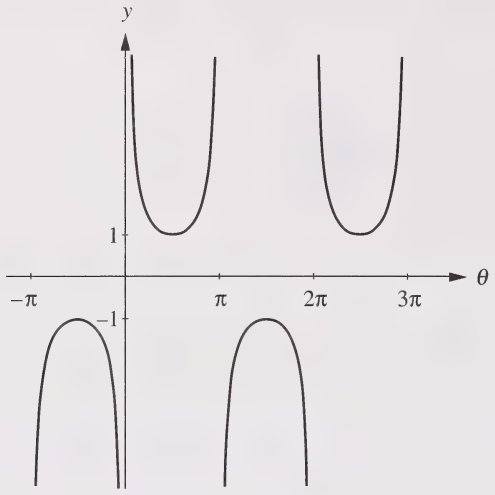
**17.** If $\theta$ is acute and $\sin^2\theta = 0.117$, then the value of $\tan\theta$ correct to nearest thousandth is

**A.** 0.118
**B.** 0.133
**C.** 0.364
**D.** 0.883

**18.** The expression $2\cos^2 27° - 1$ is equal to

**A.** $\cos 54°$
**B.** $\sec 54°$
**C.** $\cos 108°$
**D.** $\sec 108°$

**19.** The partial graph of a periodic function is shown below.




For this function, the range and period respectively are

**A.** $-1 \leq y \leq 1$ and $\pi$

**B.** $-1 \leq y \leq 1$ and $2\pi$

**C.** $y \geq 1$ or $y \leq -1$ and $\pi$

**D.** $y \geq 1$ or $y \leq -1$ and $2\pi$

**20.** The expression $\dfrac{\sec\theta \csc\theta}{\tan\theta}$ is equivalent to

**A.** $\cos^2\theta$

**B.** $\csc^2\theta$

**C.** $\sec^2\theta$

**D.** $\sin^2\theta$

**21.** If $3\tan^2\theta - 10\tan\theta = 0$ and $\theta$ is in the domain $0° < \theta \leq 90°$, then the measure of $\theta$ correct to the nearest tenth of a degree is

**A.** $16.7°$

**B.** $17.5°$

**C.** $71.6°$

**D.** $73.3°$

**22.** The graph of $y = \cos\theta$ and the graph of $y = \sin\theta$, in the domain $0 \leq \theta < 2\pi$, intersect at $\left(\frac{\pi}{4}, \frac{\sqrt{2}}{2}\right)$ and $\left(\frac{5\pi}{4}, -\frac{\sqrt{2}}{2}\right)$. If the amplitude of each graph is increased to 2, then the new points of intersection are

**A.** $\left(\frac{\pi}{4}, \frac{\sqrt{2}}{2} + 2\right)$ and $\left(\frac{5\pi}{4}, -\frac{\sqrt{2}}{2} + 2\right)$

**B.** $\left(\frac{\pi}{4}, \frac{\sqrt{2}}{2} - 2\right)$ and $\left(\frac{5\pi}{4}, -\frac{\sqrt{2}}{2} - 2\right)$

**C.** $\left(\frac{\pi}{4}, \frac{\sqrt{2}}{4}\right)$ and $\left(\frac{5\pi}{4}, -\frac{\sqrt{2}}{4}\right)$

**D.** $\left(\frac{\pi}{4}, \sqrt{2}\right)$ and $\left(\frac{5\pi}{4}, -\sqrt{2}\right)$

**23.** A small boat travels at a speed of 12 m/s. After the boat's motor stops, the boat loses half its speed every 3 seconds. Which of the following expressions describes the boat's speed, $s(t)$, $t$ seconds after the motor stops?

**A.** $s(t) = 12(3)^{\frac{t}{2}}$

**B.** $s(t) = 12\left(\frac{1}{2}\right)^{\frac{t}{3}}$

**C.** $s(t) = \left(\frac{1}{2}\right)^{\frac{t}{3}}$

**D.** $s(t) = (3)^{\frac{t}{2}}$

**24.** The exponential form of $3 = \log_b(x) + \log_b(y)$ is

**A.** $b^3 = xy$

**B.** $b^{xy} = 3$

**C.** $b^{x+y} = 3$

**D.** $b^3 = x + y$

**25.** A logarithmic form of $\frac{a^x}{a^y} = z$ is

**A.** $\log_z(a) = x - y$

**B.** $\log_a(z) = x - y$

**C.** $\log_z(a) = \frac{x}{y}$

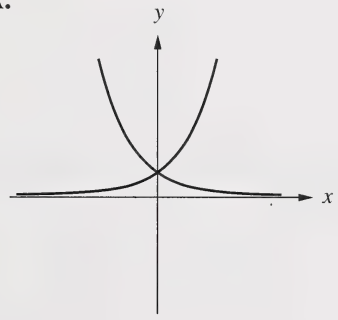
**D.** $\log_a(z) = \frac{x}{y}$

**26.** The tripling time for a specific species of bacterium is $k$ minutes. The prediction equation for the number of bacteria, $n(x)$, present after $x$ minutes is an exponential function defined by $n(x) = 5(3)^{\frac{x}{k}}$. If the point $(2, 15)$ satisfies this equation, then the predicted number of bacteria after $4$ minutes is

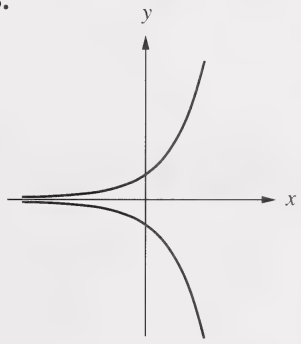
**A.** 35
**B.** 40
**C.** 44
**D.** 45

**27.** Which of the following graphs could illustrate the graph of an exponential function and that of its inverse?

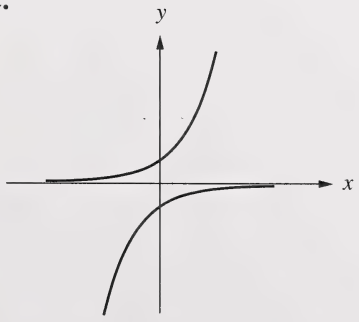
**A.**



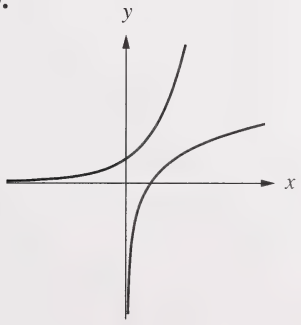

**B.**




**C.**




**D.**



**28.** If $\log_b A = M$, then $\log_b \frac{1}{A^2}$ equals

**A.** $-2M$

**B.** $-\frac{1}{2}M$

**C.** $\frac{1}{2}M$

**D.** $2M$

**29.** If $\log_3 (x-3) + \log_3 (x+3) = 0$, then the value of $x$ correct to the nearest tenth is

**A.** 3.2

**B.** 3.0

**C.** 0.5

**D.** 0

**30.** In a geometric sequence, the first term is 4 and the sum of the first three terms is 52. One possible value for the common ratio of this sequence is

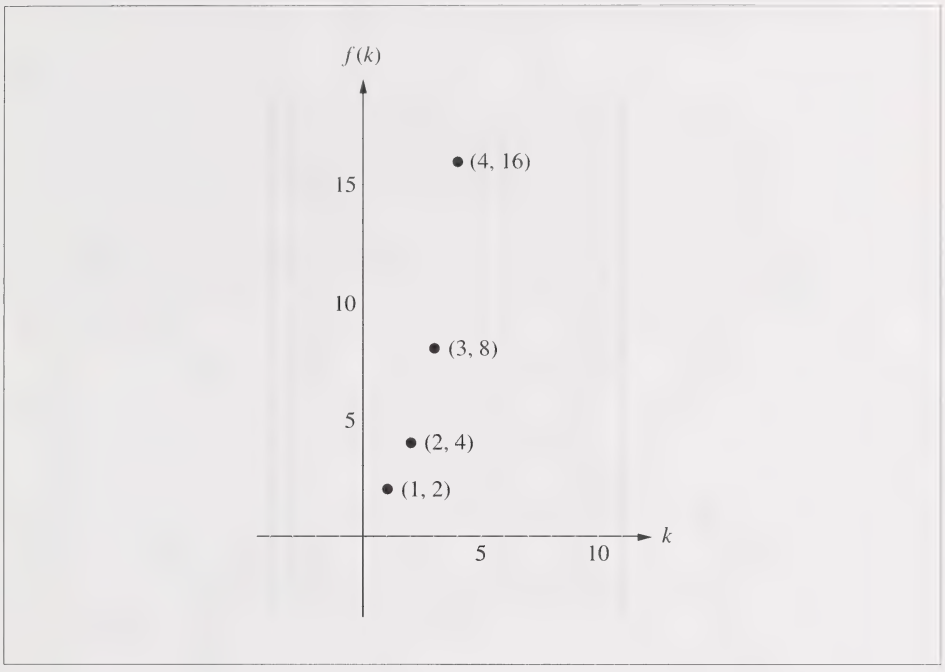
**A.** 4

**B.** 2

**C.** –2

**D.** –4

*Use the following information to answer question 31.*

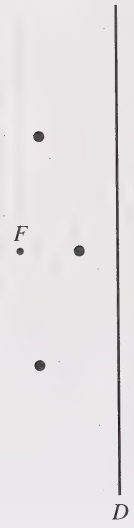



**31.** The values of the function $f(k)$, where the domain is $\{1, 2, 3, 4\}$, form

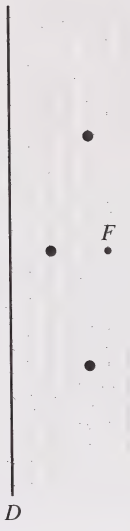
**A.** an arithmetic sequence
**B.** a geometric sequence
**C.** an arithmetic series
**D.** a geometric series

**32.** Which of the following graphs shows three points that lie on an ellipse with a focus $F$, a directrix $D$, and an eccentricity of $\frac{2}{3}$?

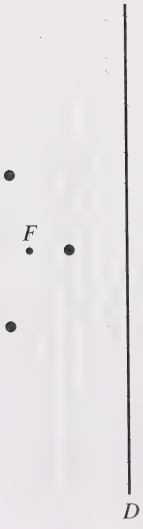
**A.**



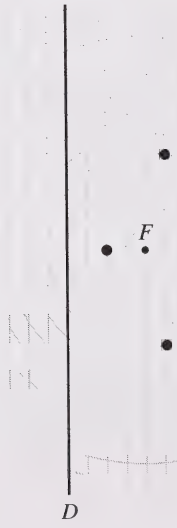

**B.**




**C.**

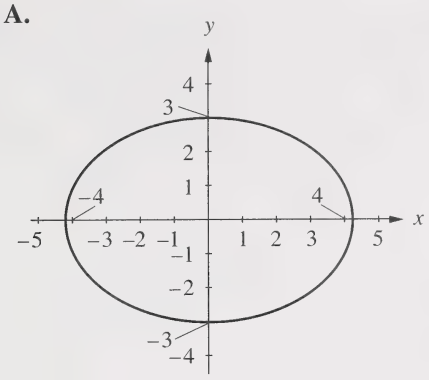



**D.**

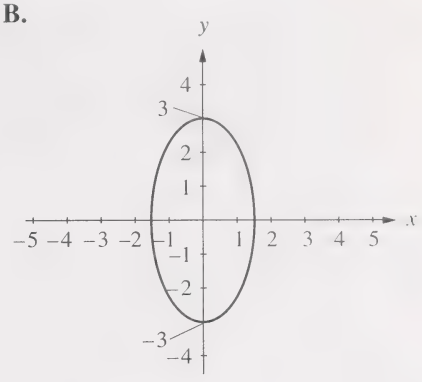


**33.** If the equation of a circle is $2x^2 + 2y^2 - 18 = 0$, then which of the following graphs is **not** possible when **only** the value of the coefficient of $x^2$ changes?

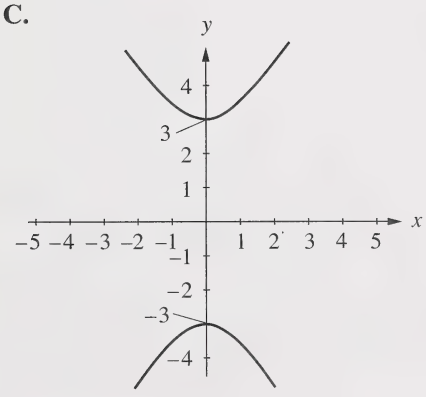
**A.**



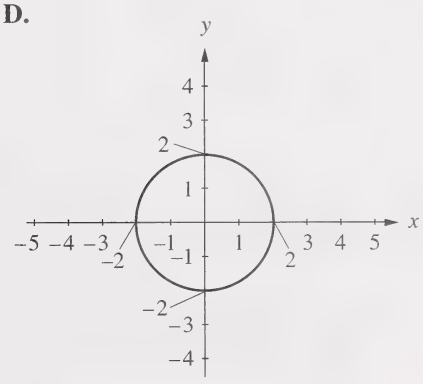

**B.**




**C.**




**D.**



**34.** When a plane cuts a circular conical surface, the resulting curve is the non-degenerate case of a parabola. Which conditions must be met for this to occur?

**A.** The plane is not parallel to the generator and does not pass through the vertex.

**B.** The plane is parallel to the generator but does not pass through the vertex.

**C.** The plane is perpendicular to the axis and passes through the vertex.

**D.** The plane is parallel to the generator and passes through the vertex.

**35.** During her investigation of ellipses, Sarah discovered an ellipse centred in the second quadrant. If $B = 0$ and $A > 0$, then the values of $D$ and $E$ in $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$ must satisfy

**A.** $D < 0,\ E < 0$

**B.** $D < 0,\ E > 0$

**C.** $D > 0,\ E < 0$

**D.** $D > 0,\ E > 0$

**36.** The directrix of a quadratic relation is $x = -6$ and the corresponding focus is (3, 0). If the quadratic relation passes through $(-1, 3)$, then the quadratic relation is

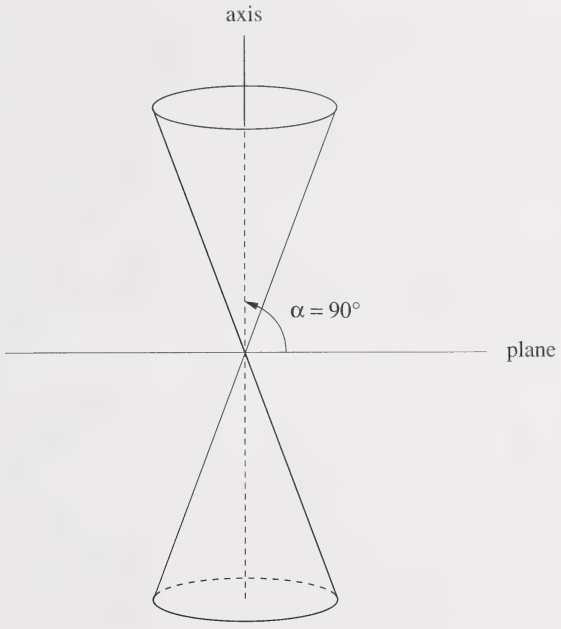
**A.** a hyperbola

**B.** a parabola

**C.** an ellipse

**D.** a circle

**37.** A plane is perpendicular to the axis of a circular conical surface and passes through its vertex.




The plane is rotated counterclockwise such that the angle $\alpha$ between the plane and the axis of the conical surface is decreased from $90°$ to $0°$ but continues to pass through the vertex. In what order would the degenerate cases of the ellipse, parabola, and hyperbola be produced?

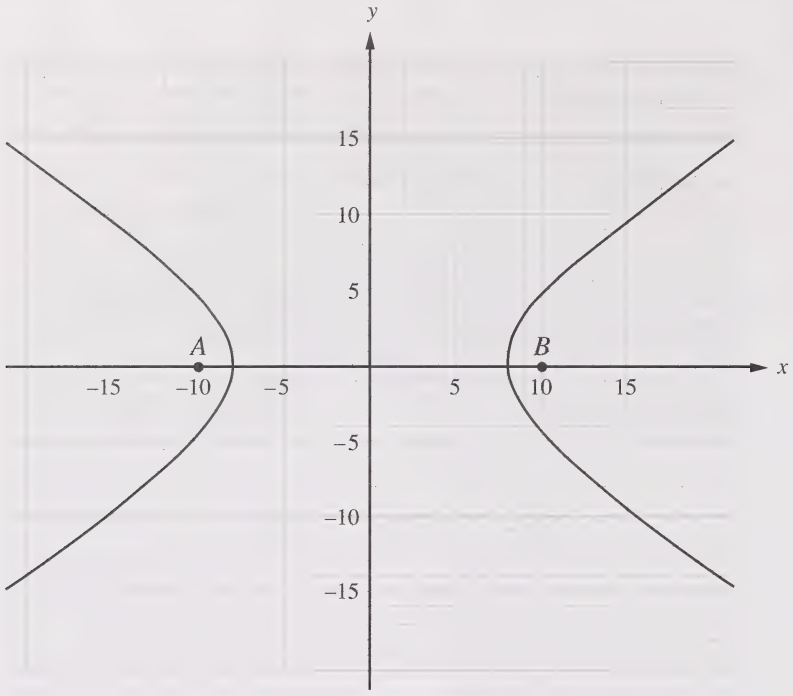
**A.** Line, point, two intersecting lines

**B.** Two intersecting lines, point, line

**C.** Point, two intersecting lines, line

**D.** Point, line, two intersecting lines

**38.** A hyperbola symmetrical with respect to the $y$-axis is shown below.




If $A$ and $B$ are the foci of this hyperbola and $P$ is any point on the hyperbola, then $|PA - PB|$ equals

**A.** 8
**B.** 10
**C.** 16
**D.** 20

**39.** After everyone has shaken hands once with everyone else at a meeting, there is a total of 105 handshakes. How many people are at the meeting?

**A.** 14
**B.** 15
**C.** 52
**D.** 53

**40.** A small-business owner wants a sign designed using only 2 colours and 1 style of print. The owner can choose from the colours red, blue, or white and from 5 styles of black print. How many different signs can be made?

**A.** 10

**B.** 11

**C.** 30

**D.** 45

**41.** In how many ways can all the letters of the word "**Montreal**" be arranged if the letters **r**, **e**, **a**, and **l** must appear as the word "**real**" in all arrangements?

**A.** 4!

**B.** 5!

**C.** $2! \times 5!$

**D.** $5! \times 4!$

**42.** In the expansion of $(2x + y)^8$, the coefficient of $x^2y^6$ is

**A.** 112

**B.** 56

**C.** 28

**D.** 16

***You have now completed Part A. Proceed directly to Part B.***

# *Part B: Numerical Response*

***7 Questions***

### *Instructions*

- Consider all numbers used in the questions to be **exact positive real** numbers and not the result of a measurement.
- Read each question carefully.
- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**
- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

### *Sample Questions and Solutions*

Correct to the nearest tenth of a radian, $40^\circ$ is equal to _____ rad.

$40^\circ = 0.6981317008\ldots$ rad

**Record 0.7 on the answer sheet** →

For the arithmetic series $-8 + (-5) + (-2) + \ldots + (85)$, the number of terms is _____.

$85 = -8 + (n - 1)(3)$

$93 = 3n - 3$

$n = 32$

**Record 32 on the answer sheet** →

***Start Part B immediately.***

**1.** If $3^x = 7$, then the value of $x$ correct to the nearest hundredth is _____ .

**2.** Correct to the nearest tenth of a degree, $\frac{3\pi}{8}$ rad is equal to _____ °.

**3.** A point on the graph of a quadratic relation is 5 units from the focus and 12 units from the directrix. Correct to the nearest hundredth, the value of the eccentricity of this quadratic relation is _____ .

**4.** If $36, 30, 25, \ldots$ are the first three terms of a geometric sequence, then the value of $t_{20}$ correct to the nearest hundredth is _____ .

**5.** One letter is selected randomly from those in the word **"Mathematics."** Correct to the nearest hundredth, the probability that the letter selected is an **a**, **e**, or **i** is _____ .

**6.** The value of $\sum_{k=1}^{10}(2)^k$ is _____ .

**7.** If $\theta$ is acute and $\log_3(\sin\theta) = -1$, then the value of $\theta$ correct to the nearest tenth of a degree is _____ °.

RECORD YOUR ANSWER ON THE ANSWER SHEET

***You have now completed Part B. Proceed directly to Part C.***

# *Part C: Written Response*

***4 Questions***

***Instructions***

- Consider all numbers used in the question to be **exact real** numbers and not the result of a measurement.
- Read each question carefully.
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers **must show all** pertinent explanations, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences for a written response, and correct units and significant digits for a numerical response.

***Note:*** *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

***Start Part C immediately.***

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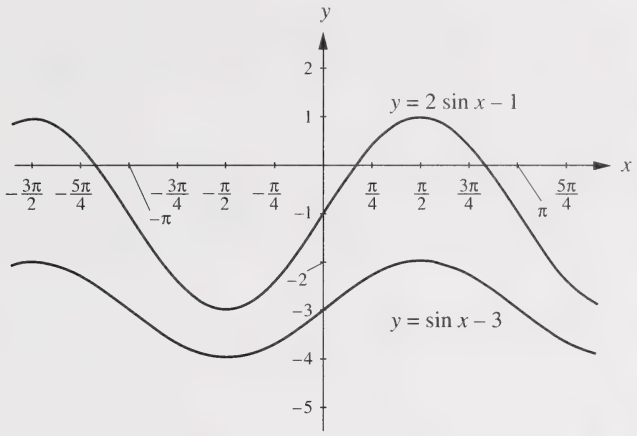
**Total: 5 marks**

**(3 marks)**

**1.** Terry began to solve the equation $2\sin^2 x - 7\sin x + 3 = 0$, $0 \le x \le 2\pi$. Terry correctly factored the equation to obtain $(2\sin x - 1)(\sin x - 3) = 0$.

**a.** Find the solution to this equation algebraically.

**b.** Terry used a computer to graph $y = 2 \sin x - 1$ and $y = \sin x - 3$ as shown below.




Explain the relationship that these two graphs have to the solution of the equation $(2 \sin x - 1)(\sin x - 3) = 0$.

**(2 marks)**

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**Total: 7 marks**

**2.** A year after compact disks were being manufactured by a particular company, the company wanted to know if students who buy cassette tapes would likely buy compact disks.

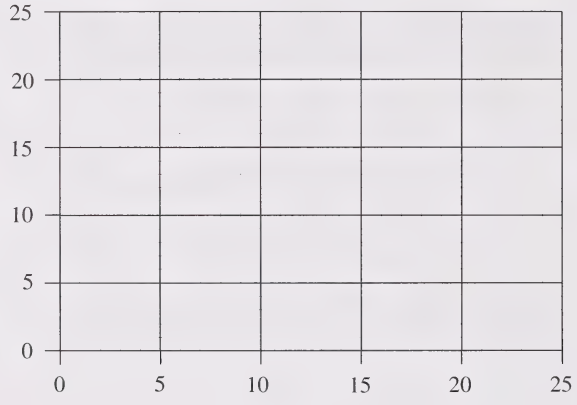
The company hired Larissa and Jason to each construct a valid survey to determine if there is a relationship between the number of cassette tapes that students own and the number of compact disks that they own.

Larissa surveyed 15 students and Jason surveyed 15 other students. Both Larissa and Jason chose to display their data on a scatter plot. Larissa's data showed an apparent positive correlation while Jason's data showed no apparent correlation between the two variables.

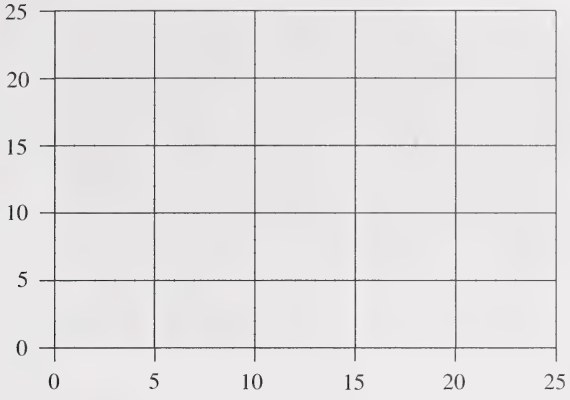
**(4 marks)**

**a.** Create data that support Larissa's and Jason's results and complete both their scatter plots on the grids provided.

**Larissa's Scatter Plot**



**Jason's Scatter Plot**




**b.** Interpret the meaning of Larissa's **or** Jason's results for the company. **(3 marks)**

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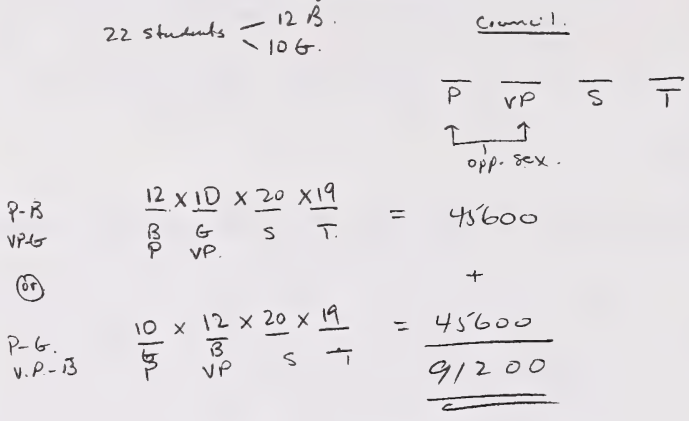
**(4 marks)**

**3.** Kelly and Chris read and answered the following question.

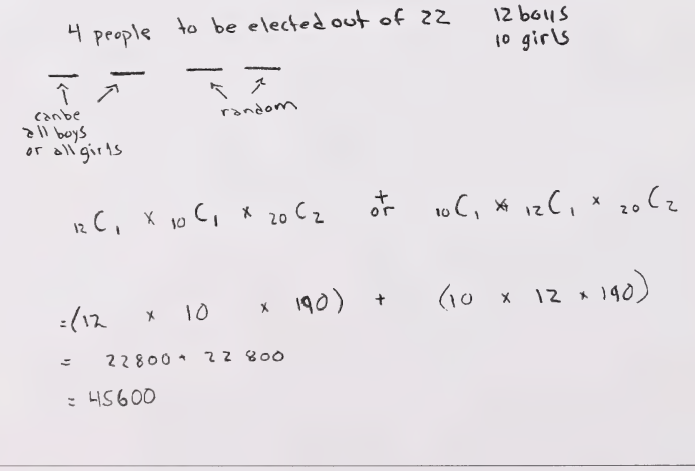
"A class of 22 students consists of 12 boys and 10 girls.
A student council consisting of a president *(P)*, vice-president *(VP)*, secretary *(S)*, and treasurer *(T)* is to be elected from the class.
The number of councils that can be elected from this class if the president and vice-president are of opposite sex is _____ ."

Their solutions and explanations are given below:

Kelly's Solution




Chris's Solution



Kelly's or Chris's solution is correct. Decide which solution is correct and clearly explain how you made your decision.

*(Question 4 begins on the next page.)*

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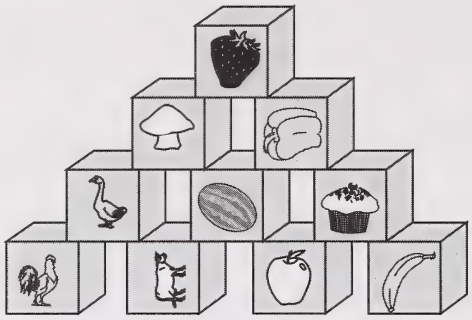
**(5 marks)**

**4.** A Grade 10 class was given 250 wooden blocks. The students were asked to build a structure using as many of the blocks as possible.

If the students continue the pattern shown below—where each successive row has one block more than the preceding row—how many blocks will they need for the bottom row? Show how you solve this problem.



***You have now completed the examination.***
***If you have time, you may wish to check your answers.***

# *Mathematics 30 Formula Sheet*

The following information may be useful in writing this examination.

- The roots of the quadratic equation $ax^2 + bx + c = 0$ are

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- The distance between two points $(x_1, y_1)$ and $(x_2, y_2)$ is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

**Quadratic Relations**

- $e = \dfrac{|\overline{PF}|}{|\overline{PD}|}$

**Trigonometry**

- arc length $a = r\theta$
- $\sin^2 A + \cos^2 A = 1$
- $1 + \tan^2 A = \sec^2 A$
- $1 + \cot^2 A = \csc^2 A$
- $\csc A = \dfrac{1}{\sin A}$
- $\sec A = \dfrac{1}{\cos A}$
- $\cot A = \dfrac{\cos A}{\sin A}$
- $\sin(A + B) = \sin A \cos B + \cos A \sin B$
- $\sin(A - B) = \sin A \cos B - \cos A \sin B$
- $\cos(A + B) = \cos A \cos B - \sin A \sin B$
- $\cos(A - B) = \cos A \cos B + \sin A \sin B$

**Permutations and Combinations**

- ${}_nP_r = \dfrac{n!}{(n-r)!}$
- ${}_nC_r = \dfrac{n!}{r!(n-r)!}$
- In the expansion of $(x + y)^n$, the general term is $t_{k+1} = {}_nC_k x^{n-k} y^k$

**Sequences and Series**

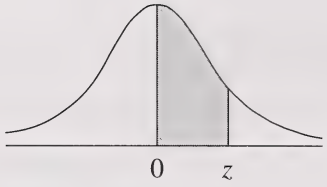
- $t_n = a + (n-1)d$
- $S_n = \dfrac{n[2a + (n-1)d]}{2}$
- $S_n = n\left(\dfrac{a + t_n}{2}\right)$
- $t_n = ar^{n-1}$
- $S_n = \dfrac{a(r^n - 1)}{r - 1}$, $r \neq 1$
- $S_n = \dfrac{rt_n - a}{r - 1}$, $r \neq 1$

**Exponential and Logarithmic Functions**

- $\log_a mn = \log_a m + \log_a n$
- $\log_a \dfrac{m}{n} = \log_a m - \log_a n$
- $\log_a m^n = n \log_a m$

*Fold and tear along perforation.*

$$z = \frac{x - \mu}{\sigma}$$




***Areas under the Standard Normal Curve***

| $z$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0000 | 0.0040 | 0.0080 | 0.0120 | 0.0160 | 0.0199 | 0.0239 | 0.0279 | 0.0319 | 0.0359 |
| 0.1 | 0.0398 | 0.0438 | 0.0478 | 0.0517 | 0.0557 | 0.0596 | 0.0636 | 0.0675 | 0.0714 | 0.0754 |
| 0.2 | 0.0793 | 0.0832 | 0.0871 | 0.0910 | 0.0948 | 0.0987 | 0.1026 | 0.1064 | 0.1103 | 0.1141 |
| 0.3 | 0.1179 | 0.1217 | 0.1255 | 0.1293 | 0.1331 | 0.1368 | 0.1406 | 0.1443 | 0.1480 | 0.1517 |
| 0.4 | 0.1554 | 0.1591 | 0.1628 | 0.1664 | 0.1700 | 0.1736 | 0.1772 | 0.1808 | 0.1844 | 0.1879 |
| 0.5 | 0.1915 | 0.1950 | 0.1985 | 0.2019 | 0.2054 | 0.2088 | 0.2123 | 0.2157 | 0.2190 | 0.2224 |
| 0.6 | 0.2258 | 0.2291 | 0.2324 | 0.2357 | 0.2389 | 0.2422 | 0.2454 | 0.2486 | 0.2518 | 0.2549 |
| 0.7 | 0.2580 | 0.2612 | 0.2642 | 0.2673 | 0.2704 | 0.2734 | 0.2764 | 0.2794 | 0.2823 | 0.2852 |
| 0.8 | 0.2881 | 0.2910 | 0.2939 | 0.2967 | 0.2996 | 0.3023 | 0.3051 | 0.3078 | 0.3106 | 0.3133 |
| 0.9 | 0.3159 | 0.3186 | 0.3212 | 0.3238 | 0.3264 | 0.3289 | 0.3315 | 0.3340 | 0.3365 | 0.3389 |
| 1.0 | 0.3413 | 0.3438 | 0.3461 | 0.3485 | 0.3508 | 0.3531 | 0.3554 | 0.3577 | 0.3599 | 0.3621 |
| 1.1 | 0.3643 | 0.3665 | 0.3686 | 0.3708 | 0.3729 | 0.3749 | 0.3770 | 0.3790 | 0.3810 | 0.3830 |
| 1.2 | 0.3849 | 0.3869 | 0.3888 | 0.3907 | 0.3925 | 0.3944 | 0.3962 | 0.3980 | 0.3997 | 0.4015 |
| 1.3 | 0.4032 | 0.4049 | 0.4066 | 0.4082 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4162 | 0.4177 |
| 1.4 | 0.4192 | 0.4207 | 0.4222 | 0.4236 | 0.4251 | 0.4265 | 0.4279 | 0.4292 | 0.4306 | 0.4319 |
| 1.5 | 0.4332 | 0.4345 | 0.4357 | 0.4370 | 0.4382 | 0.4394 | 0.4406 | 0.4418 | 0.4429 | 0.4441 |
| 1.6 | 0.4452 | 0.4463 | 0.4474 | 0.4484 | 0.4495 | 0.4505 | 0.4515 | 0.4525 | 0.4535 | 0.4545 |
| 1.7 | 0.4554 | 0.4564 | 0.4573 | 0.4582 | 0.4591 | 0.4599 | 0.4608 | 0.4616 | 0.4625 | 0.4633 |
| 1.8 | 0.4641 | 0.4649 | 0.4656 | 0.4664 | 0.4671 | 0.4678 | 0.4686 | 0.4693 | 0.4699 | 0.4706 |
| 1.9 | 0.4713 | 0.4719 | 0.4726 | 0.4732 | 0.4738 | 0.4744 | 0.4750 | 0.4756 | 0.4761 | 0.4767 |
| 2.0 | 0.4772 | 0.4778 | 0.4783 | 0.4788 | 0.4793 | 0.4798 | 0.4803 | 0.4808 | 0.4812 | 0.4817 |
| 2.1 | 0.4821 | 0.4826 | 0.4830 | 0.4834 | 0.4838 | 0.4842 | 0.4846 | 0.4850 | 0.4854 | 0.4857 |
| 2.2 | 0.4861 | 0.4864 | 0.4868 | 0.4871 | 0.4875 | 0.4878 | 0.4881 | 0.4884 | 0.4887 | 0.4890 |
| 2.3 | 0.4893 | 0.4896 | 0.4898 | 0.4901 | 0.4904 | 0.4906 | 0.4909 | 0.4911 | 0.4913 | 0.4916 |
| 2.4 | 0.4918 | 0.4920 | 0.4922 | 0.4925 | 0.4927 | 0.4929 | 0.4931 | 0.4932 | 0.4934 | 0.4936 |
| 2.5 | 0.4938 | 0.4940 | 0.4941 | 0.4943 | 0.4945 | 0.4946 | 0.4948 | 0.4949 | 0.4951 | 0.4952 |
| 2.6 | 0.4953 | 0.4955 | 0.4956 | 0.4957 | 0.4959 | 0.4960 | 0.4961 | 0.4962 | 0.4963 | 0.4964 |
| 2.7 | 0.4965 | 0.4966 | 0.4967 | 0.4968 | 0.4969 | 0.4970 | 0.4971 | 0.4972 | 0.4973 | 0.4974 |
| 2.8 | 0.4974 | 0.4975 | 0.4976 | 0.4977 | 0.4977 | 0.4978 | 0.4979 | 0.4979 | 0.4980 | 0.4981 |
| 2.9 | 0.4981 | 0.4982 | 0.4982 | 0.4983 | 0.4984 | 0.4984 | 0.4985 | 0.4985 | 0.4986 | 0.4986 |
| 3.0 | 0.4987 | 0.4987 | 0.4987 | 0.4988 | 0.4988 | 0.4989 | 0.4989 | 0.4989 | 0.4990 | 0.4990 |
| 3.1 | 0.4990 | 0.4991 | 0.4991 | 0.4991 | 0.4992 | 0.4992 | 0.4992 | 0.4992 | 0.4993 | 0.4993 |
| 3.2 | 0.4993 | 0.4993 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4995 | 0.4995 | 0.4995 |
| 3.3 | 0.4995 | 0.4995 | 0.4995 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4997 |
| 3.4 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4998 |
| 3.5 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 | 0.4998 |
| 3.6 | 0.4998 | 0.4998 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.7 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.8 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 | 0.4999 |
| 3.9 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 |

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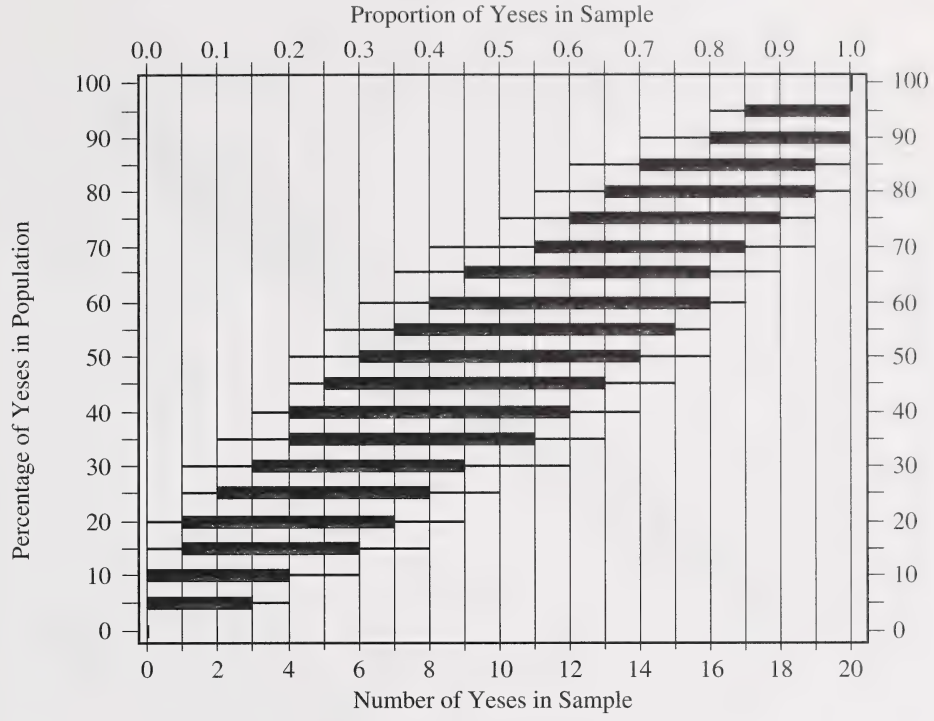
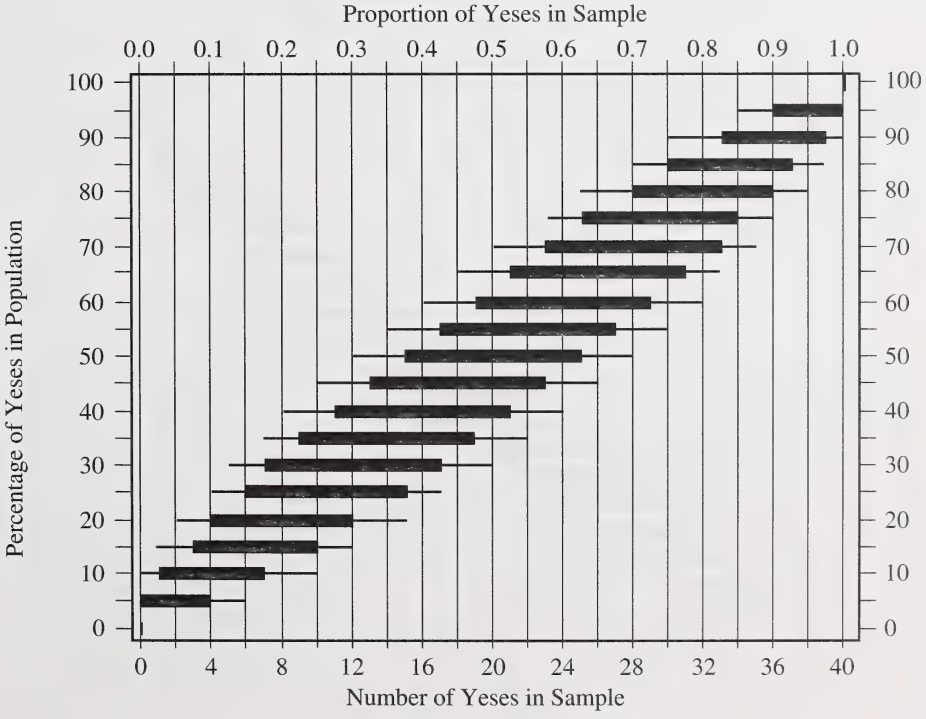
**90% Box Plots from Samples of Size 20**




**90% Box Plots from Samples of Size 40**

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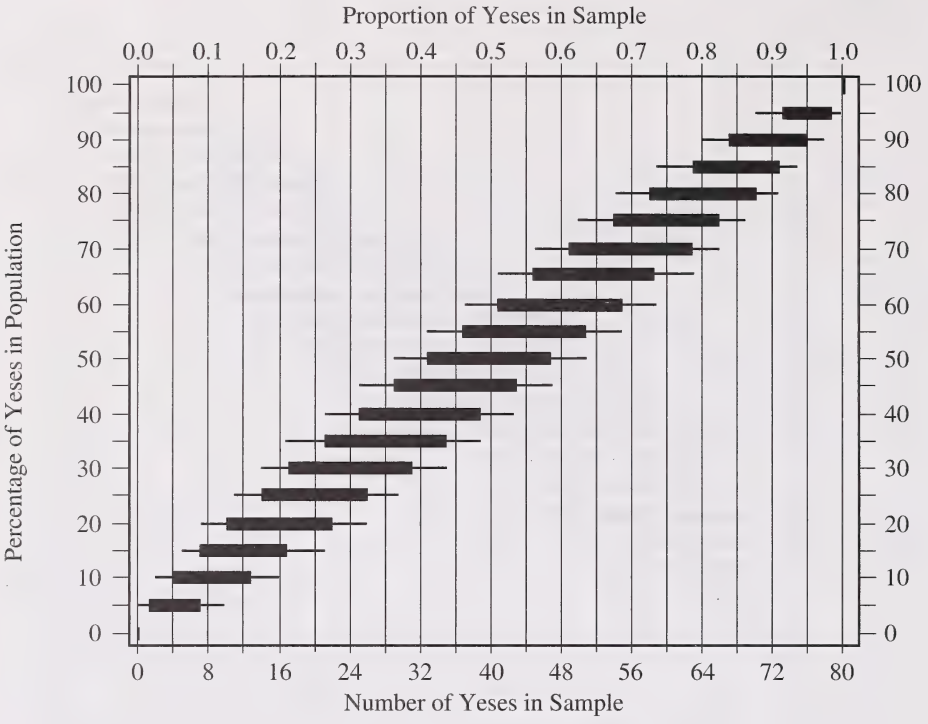


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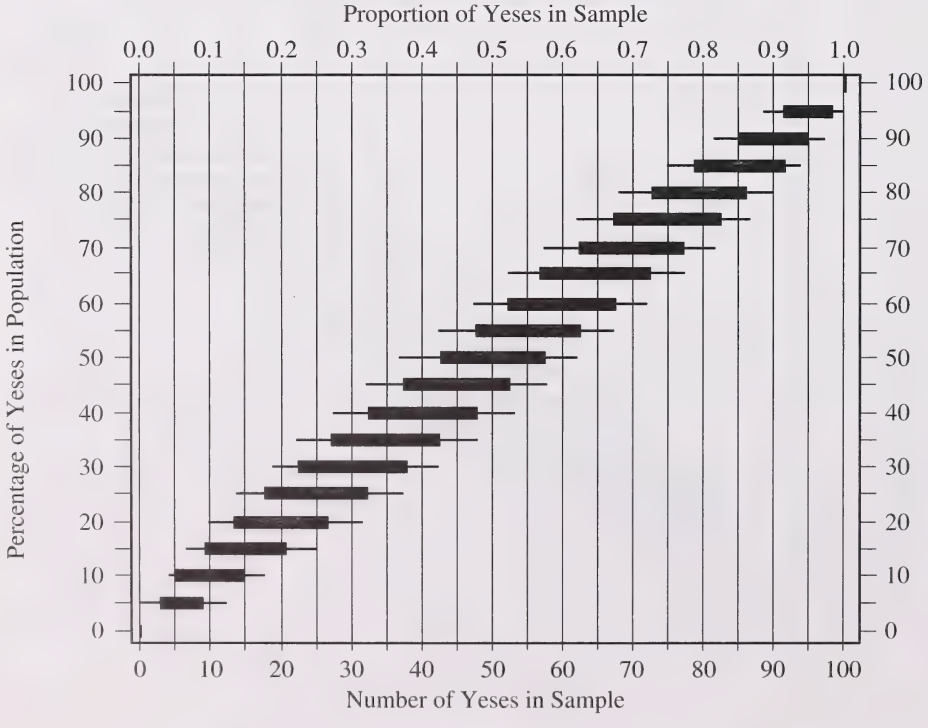


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# Mathematics 30

## June 1994

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